IEEE CONTROL SYSTEMS SOCIETY
TECHNICAL COMMITTEE ON DISCRETE EVENT SYSTEMS

Newsletter..... June 2019

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Contents:

1. Editorial

Welcome to the 2019 May issue of the newsletter,
also available electronically at
http://discrete-event-systems.ieeecss.org/tc-discrete/newsletters

You are welcome to submit new items to the newsletter (topics including schools,
workshops, sessions, conferences, journals, books, software, positions).
To submit a new item, please use the following website:
https://www.control.eng.osaka-cu.ac.jp/miscellaneous/css-tc-des/submission
or email to kai.cai@eng.osaka-cu.ac.jp.

To subscribe, please email to kai.cai@eng.osaka-cu.ac.jp.
To unsubscribe, please reply to this email with the subject line UNSUBSCRIBE.

2. Technical Committee Meeting at ACC 2019

Technical Committee on Discrete Event Systems will hold a meeting at American Control Conference 2019, Philadelphia, PA, USA.

Time: 12:00--13:30, July 12, Friday, 2019.
Location: TBD

All TC members who are going to attend ACC'19 are welcome to come to this meeting. Lunch is supplied (first come first served, due to limited amount).

3. Selections of Journal Publications

Contributed by: Xiang Yin (yinxiang@sjtu.edu.cn)

3.1. Selections of Automatica
VOLUME: 104, June 2019

(1) Deciding detectability for labeled Petri nets

Authors: Tomas Masopust ; Xiang Yin

Abstract: Detectability of discrete event systems is a property to decide whether the current and subsequent states can be determined based on observations. We investigate the existence of algorithms for checking strong and weak detectability for systems modeled as labeled Petri nets. Strong detectability requires that we can always determine, after a finite number of observations, the current and subsequent markings of the system, while weak detectability requires that we can determine, after a finite number of observations, the current and subsequent markings for some trajectories of the system. We show that there is an algorithm to check strong detectability requiring exponential space, and that there is no algorithm to check weak detectability.

Full-text available at: https://www.sciencedirect.com/science/article/pii/S000510981930113X

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3.2. Selections of the IEEE Transactions on Automatic Control
VOLUME: 64, ISSUE: 6, June 2019

(1) Symbolic Optimal Control

Authors: Gunther Reissig ; Matthias Rungger

Abstract: We present novel results on the solution of a class of leavable, undiscounted optimal control problems in the minimax sense for nonlinear, continuous-state, discrete-time plants. The problem class includes entry-(exit-)time problems as well as minimum-time, pursuit-evasion, and reach-avoid games as special cases. We utilize auxiliary optimal control problems (°∞abstractions°±) to compute both upper bounds of the value function, i.e., of the achievable closed-loop performance, and symbolic feedback controllers realizing those bounds. The abstractions are obtained from discretizing the problem data, and we prove that the computed bounds and the performance of the symbolic controllers converge to the value function as the discretization parameters approach zero. In particular, if the optimal control problem is solvable on some compact subset of the state space, and if the discretization parameters are sufficiently small, then we obtain a symbolic feedback controller solving the problem on that subset. These results do not assume the continuity of the value function or any problem data, and they fully apply in the presence of hard state and control constraints.

Full-text available at: https://ieeexplore.ieee.org/document/8424895

(2) Compositional Synthesis of Finite-State Abstractions

Authors: Kaushik Mallik ; Anne-Kathrin Schmuck ; Sadegh Soudjani ; Rupak Majumdar

Abstract: Controller-synthesis techniques for continuous systems with respect to temporal logic specifications typically use a finite-state symbolic abstraction of the system model. Constructing this abstraction for the entire system is computationally expensive, and does not exploit natural decompositions of many systems into interacting components. We describe a methodology for compositional symbolic abstraction to help scale controller synthesis for temporal logic to larger systems. We introduce disturbance bisimulation , which strengthens the standard approximate alternating bisimulation relation used in control. It extends naturally to systems that are composed of weakly interconnected subcomponents, possibly connected in feedback, and models the coupling signals as disturbances. We show how networks of incrementally input-to-state stable, nonlinear, continuous-time control systems can be abstracted compositionally, so that all local abstractions are simultaneously disturbance bisimilar to their continuous counterparts. Furthermore, our construction ensures that the final composed abstraction is disturbance bisimilar to the original system. Finally, we discuss how we get a compositional abstraction-based controller-synthesis methodology for networks of such systems against local temporal specifications as a byproduct of our construction.

Full-text available at: https://ieeexplore.ieee.org/document/8462741

(3) Learning Policies for Markov Decision Processes From Data

Authors: Manjesh Kumar Hanawal ; Hao Liu ; Henghui Zhu ; Ioannis Ch. Paschalidis

Abstract: We consider the problem of learning a policy for a Markov decision process consistent with data captured on the state-action pairs followed by the policy. We parameterize the policy using features associated with the state-action pairs. The features can be handcrafted or defined using kernel functions in a reproducing kernel Hilbert space. In either case, the set of features can be large and only a small, unknown subset may need to be used to fit a specific policy to the data. The parameters of such a policy are recovered using ?1 -regularized logistic regression. We establish bounds on the difference between the average reward of the estimated and the unknown original policies (regret) in terms of the generalization error and the ergodic coefficient of the underlying Markov chain. To that end, we combine sample complexity theory and sensitivity analysis of the stationary distribution of Markov chains. Our analysis suggests that to achieve regret within order O(?°Ã) , it suffices to use training sample size of the order of ¶∏(logn?poly(1/?)) , where n is the number of the features. We demonstrate the effectiveness of our method on a synthetic robot navigation example.

Full-text available at: https://ieeexplore.ieee.org/document/8443086

(4) Stability of Stochastic Approximations With Controlled Markov Noise and Temporal Difference Learning

Authors: Arunselvan Ramaswamy ; Shalabh Bhatnagar

Abstract: We are interested in understanding stability (almost sure boundedness) of stochastic approximation algorithms (SAs) driven by a °∞controlled Markov°± process. Analyzing this class of algorithms is important, since many reinforcement learning (RL) algorithms can be cast as SAs driven by a °∞controlled Markov°± process. In this paper, we present easily verifiable sufficient conditions for stability and convergence of SAs driven by a °∞controlled Markov°± process. Many RL applications involve continuous state spaces. While our analysis readily ensures stability for such continuous state applications, traditional analyses do not. As compared to literature, our analysis presents a two-fold generalization: 1) the Markov process may evolve in a continuous state space and 2) the process need not be ergodic under any given stationary policy. Temporal difference (TD) learning is an important policy evaluation method in RL. The theory developed herein, is used to analyze generalized TD(0) , an important variant of TD. Our theory is also used to analyze a TD formulation of supervised learning for forecasting problems.

Full-text available at: https://ieeexplore.ieee.org/document/8485741

(5) Tradeoffs in Stochastic Event-Triggered Control

Authors: Burak Demirel ; Alex S. Leong ; Vijay Gupta ; Daniel E. Quevedo

Abstract: This paper studies the optimal output-feedback control of a linear time-invariant system where a stochastic event-based scheduler triggers the communication between the sensor and the controller. The primary goal of the use of this type of scheduling strategy is to provide significant reductions in the usage of the sensor-to-controller communication and, in turn, improve energy expenditure in the network. In this paper, we aim to design an admissible control policy, which is a function of the observed output, to minimize a quadratic cost function while employing a stochastic event-triggered scheduler that preserves the Gaussian property of the plant state and the estimation error. For the infinite horizon case, we present analytical expressions that quantify the tradeoff between the communication cost and control performance of such event-triggered control systems. This tradeoff is confirmed quantitatively via numerical examples. Besides, numerical simulations justify that the event-triggered control provides better quadratic control performance than the (traditional) periodic time-triggered control at the same average sampling rate.

Full-text available at: https://ieeexplore.ieee.org/document/8472169
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3.3. Selections of the IEEE Transactions on Systems, Man, and Cybernetics: Systems
VOLUME: 49, ISSUE: 26, June 2019

(1) Complex Reachability Trees and Their Application to Deadlock Detection for Unbounded Petri Nets

Authors: Faming Lu ; Qingtian Zeng ; MengChu Zhou ; Yunxia Bao ; Hua Duan

Abstract: Deadlock detection plays an important role in the analysis of system behavior. Several kinds of reachability trees have been proposed to analyze Petri net properties including deadlock freedom. However, existing reachability trees can only solve the deadlock detection problem of bounded or some special kinds of unbounded Petri nets. To increase the applicable scope of reachability trees in the deadlock detection field, this paper presents a new type of reachability trees called complex reachability tree (CRT). Different from others, transition sequences corresponding to root-started paths of cyclic CRTs are always firable from the initial marking. The proposed trees can completely solve the deadlock detection problem of ¶ÿ -gone node-free Petri nets, but cannot guarantee to detect all the deadlocks for the other kinds of unbounded Petri nets. Their construction method and applications are presented.

Full-text available at: https://ieeexplore.ieee.org/document/7920387

(2) Robust Scheduling of Time-Constrained Dual-Arm Cluster Tools With Wafer Revisiting and Activity Time Disturbance

Authors: Yan Qiao ; NaiQi Wu ; FaJun Yang ; MengChu Zhou ; QingHua Zhu ; Ting Qu

Abstract: Wafer revisiting and residency time constraints complicate the scheduling problem of cluster tools in semiconductor manufacturing. Random disturbance to the activity time in operating a tool further complicates such a scheduling problem. To solve this challenging problem, this paper proposes a robust real-time schedule which consists of a real-time controller (RTC) and an off-line schedule. The former is developed to offset the activity time disturbance such that the wafer sojourn time fluctuation in a process module is minimized. With the RTC, to find the off-line schedule, necessary and sufficient schedulability conditions under which a feasible schedule exists are derived and these conditions can be easily checked. Then, the off-line schedule can be efficiently found by the proposed algorithms based on nondisturbed activity time if a feasible schedule exists. With the obtained real-time schedule, it is shown that the productivity of the system is maximized. Finally, examples are used to illustrate the proposed approach.

Full-text available at: https://ieeexplore.ieee.org/document/7995128

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3.4. Selections of the IEEE Control Systems Letters
VOLUME: 3, ISSUE: 3, July 2019

(1) Supervisor Synthesis for FMS Based on Critical Activity Places

Author: Wei Zheng ; Hai Lin

Abstract: Human®Crobot collaboration (HRC) has emerged as a hot research area at the intersection of control, robotics, and psychology in recent years. It is of critical importance to obtain an expressive but meanwhile tractable model for human beings in HRC. In this letter, we propose a model called vector autoregressive partially observable Markov decision process (VAR-POMDP) which is an extension of the traditional POMDP model by considering the correlation among observations. The VAR-POMDP model is more powerful in the expressiveness of features than the traditional continuous observation POMDP since the traditional one is a special case of the VAR-POMDP model. Meanwhile, the proposed VAR-POMDP model is also tractable, as we show that it can be effectively learned from data and we can extend point-based value iteration (PBVI) to VAR-POMDP planning. Particularly, in this letter, we propose to use the Bayesian non-parametric learning to decide potential human states and learn a VAR-POMDP model using data collected from human demonstrations. Then, we consider planning with respect to PCTL which is widely used as safety and reachability requirement in robotics. Finally, the advantage of using the proposed model for HRC is validated by experimental results using data collected from a driver-assistance test-bed.

Full-text available at: https://ieeexplore.ieee.org/document/8718309

(2) Control Barrier Functions for Multi-Agent Systems Under Conflicting Local Signal Temporal Logic Tasks

Author: Lars Lindemann ; Dimos V. Dimarogonas

Abstract: Motivated by the recent interest in cyber-physical and interconnected autonomous systems, we study the problem of dynamically coupled multi-agent systems under conflicting local signal temporal logic (STL) tasks. Each agent is assigned a local STL task regardless of the tasks that the other agents are assigned to. Such a task may be dependent, i.e., the satisfaction of the task may depend on the behavior of more than one agent, so that the satisfaction of the conjunction of all local tasks may be conflicting. We propose a hybrid feedback control strategy using time-varying control barrier functions. Our control strategy finds least violating solutions in the aforementioned conflicting situations based on a suitable robustness notion and by initiating collaboration among agents.

Full-text available at: https://ieeexplore.ieee.org/document/8718798

(3) Event-Based State Estimation Under the Presence of Multiplicative Measurement Noise

Author: Swapna Challagundla ; Shaikshavali Chitraganti ; Samir Aberkane

Abstract: An event-based state estimation problem for a discrete-time system when the measurements are corrupted with multiplicative noise is considered in this letter. A general event-based sampling is employed to obtain the measurements, where the event-based strategy is implicitly utilized to obtain state estimate and covariance. To deal with multiplicative noise, maximum a posteriori (MAP) estimator is used in conjunction with the Newton-Raphson iterative method. The proposed results are depicted using a numerical example.

Full-text available at: https://ieeexplore.ieee.org/document/8709719

4. Conferences

Contributed by: Xiang Yin (yinxiang@sjtu.edu.cn)

4.1 2019 European Control Conference
Naples, Italy, Jun 25 - Jun 28, 2019
https://ecc19.eu/

4.2 27th Mediterranean Conference on Control and Automation
Akko, Israel, Jul 1 - Jul 4, 2019
https://med19.net.technion.ac.il/

4.3 2019 American Control Conference
Philadelphia, Pennsylvania, United States, Jul 10 - Jul 12, 2019
http://acc2019.a2c2.org/

4.4 38th Chinese Control Conference (CCC 2019)
Guangzhou, China, Jul 27 - Jul 30, 2019
http://www.ccc2019.cn/en/index.html

4.5 2019 Conference on Control Technology and Applications
Hong Kong, China, Aug 19 - Aug 21, 2019
http://ccta2019.ieeecss.org/

4.6 15th International Conference on Automation Science and Engineering
Vancouver, British Columbia, Canada, Aug 22 - Aug 26, 2019
http://case2019.hust.edu.cn/index.htm

4.7 57th Annual Allerton Conference on Communication, Control, and Computing
Allerton Park, United States, Sep 24 - Sep 27, 2019

4.8 2019 Conference on Decision and Control
Nice, France, December 11-13, 2019
https://cdc2019.ieeecss.org/

5. Books

5.1 Supervisory Control of Discrete-Event Systems
Authors: W.Murray Wonham, Kai Cai
Publisher: Springer International Publishing
Series: Communications and Control Engineering
Date: 2019
Number of pages: 489
Website: https://www.springer.com/in/book/9783319774510

5.2 A Relaxation-Based Approach to Optimal Control of Hybrid Systems: A Practical Guide for Engineers
Author: Vadim Azhmyakov
Publisher: Butterworth-Heinemann
Date: February 2019
Number of pages: 434
Website: https://www.elsevier.com/books/a-relaxation-based-approach-to-optimal-control-of-hybrid-and-switched- systems/azhmyakov/
978-0-12-814788-7